U. S. DEPARTMENT OF AGRICULTURE.

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TOMATOES.

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U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
OFFICE OF THE CHIEF,
Washington, D. C., March 7, 1905.

SIR: I have the honor to transmit herewith a paper on Tomatoes, prepared by Prof. L. C. Corbett, Horticulturist of this Bureau, and recommend that it be published as a Farmers' Bulletin to supersede the publication on this subject (Farmers' Bulletin No. 76) issued in 1898.

Respectfully,

B. T. GALLOWAY,
Chief of Bureau.

Hon. JAMES WILSON,
Secretary of Agriculture.

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INTRODUCTION.

The tomato is one of the few garden vegetables of American origin holding high rank as a commercial crop which has come into general cultivation within the last century. This plant, because of its relation to the nightshade family, was for a long time held in disrepute by gardeners and people generally. For at least a century after the tomato was more or less familiar to botanists and gardeners it was very sparingly cultivated, and when grown at all was used chiefly as an ornamental plant. Its cultivation was, therefore, markedly delayed, and it was not until after the strong prejudice that the tomato was poisonous was broken down that its cultivation began to attract attention and its use became general.

The cultivation of the tomato in England and the United States came much later than it did in the countries bordering the Mediterranean. Climatic conditions undoubtedly had much to do with this. Because of the warm climate and otherwise congenial conditions existing in the Mediterranean countries the tomato flourished there. In England, however, because of the comparatively short season and small amount of heat during the growing period, the cultivation of this plant gained slowly. Even now the cultivation of the tomato in Great Britain is chiefly confined to house and protected walls. In the United States, after the plant was once introduced and its poisonous effects were discredited, its cultivation grew rapidly, and now we find it among the most generally cultivated of our garden vegetables.

As before stated, the tomato is of American origin. The exact location from which the plants first carried to Europe were secured is not definitely known, but historical evidence indicates that these plants were taken from Peru.

TYPES OF TOMATOES.

There are now a number of distinct types of the tomato in cultivation, three of which are worthy of mention, namely, the Currant type, the Cherry type, and the common commercial type, of which there are many varieties.

The Currant tomato is a weak-growing, small-leaved, small-fruited plant, bearing its fruit in large currant-like clusters, the individual fruits being about one-fourth inch in diameter, and usually red in color.

The Cherry tomato is somewhat similar in habit of growth, though more robust, with larger foliage and with fruits borne in large clusters and the individual fruits much larger in size, varying from one-half to five-eighths inch in diameter, and in some extreme cases fruits three-fourths inch in diameter have been obtained. The smooth spherical fruits of these two classes are usually two-celled and very regular in size and shape.

The plant of the commercial tomato is robust in habit of growth as compared with that of the Currant or Cherry type. The most characteristic and probably the normal habit of the plant is spreading, with large, open, compound leaves, and comparatively small, ordinarily flat, or somewhat rolled leaflets. It may, however, be upright in habit, with large, much-wrinkled leaves, giving the plant a very compact and sturdy appearance, as in the Dwarf Champion group. In another group, known as the Potato Leaf, the leaflets are large and flat, but quite pubescent, giving the plant a luxuriant appearance. The normal and most characteristic form of the tomato, however, has a decumbent habit of growth, open compound leaves, with comparatively small leaflets or subdivisions.

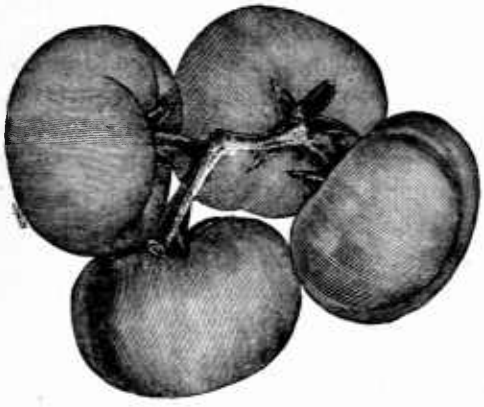

FIG. 1.—Globular, regularly formed fruits, such as occur in the Stone, Beauty, and Perfection varieties.

It is not necessary at this place to enter into a description of the botanical relations of these different types and forms. Enough has been said to show that there is more than one species and that the tomato is remarkably variable. This is also carried out in the form and color of the fruit, as well as in the habit of the plant and in the forms of the leaves. The fruits vary in size from that of the Currant to the large irregular forms of the Beefsteak variety. They vary in color from the deep red of the Cherry through various shades to the purple of the Beauty and the yellow of the Golden Queen. The form of the fruit also varies from the spherical type of the Currant and Cherry to periform and turbinated, and from the broad, flat forms of the Beefsteak to the globular, regularly formed fruits, such as occur in the Stone, Beauty, and Perfection varieties, as shown in figure 1.

LENGTHENING THE GROWING SEASON.

Because of the tropical origin of the tomato it requires a long season for its growth and development, and on this account it is necessary in the Northern States, in order to secure paying crops, to resort to methods which lengthen the growing season. It is much easier for the gardener to accomplish this while the plant is small than when it is large, and because early fruits are as a rule more valuable than late ones it is of advantage to the gardener to secure his crop as early in the season as practicable. The season is, therefore, lengthened at the beginning rather than at the end. This is accomplished by sowing seeds in hotbeds or greenhouses several weeks in advance of the time when they could be safely planted in the open.

In the latitude of New York City it is the common practice to sow the seeds of the tomato about March 15, while farther south it is customary to sow them somewhat earlier, from the 10th to the 15th of February, and as the more southern latitudes are approached even earlier dates of planting are resorted to. In Florida and southern Texas plantings are made in November, so that the fruits come into the market several weeks in advance of the earliest northern-grown fruits. It is evident from what has been said that the tomato has no fixed period of growth. In fact, in climates where its growth is not interrupted by frosts it becomes a perennial plant, but in temperate regions where seasons are markedly distinct it is forced to acquire an annual habit and to be treated as an annual plant.

Since the prejudice in regard to the poisonous qualities of the fruit has been broken down and improved canning processes have come into use the tomato has become a very important commercial field and garden crop. It is a fruit which, as before stated, has no definite season. It is relished at all periods of the year in a fresh state, and is equally welcome upon the table, when properly cooked or prepared, whether it has been freshly taken from the vines or has been preserved in cans. As a result of the extensive use of the tomato it is now cultivated both as a field and as a forced crop, and in this publication we shall consider it under both heads.

THE TOMATO AS A FIELD CROP AT THE NORTH.

East of the Mississippi River and north of the latitude of Washington, D. C., the tomato is handled as an annual, the seeds being sown in hotbeds about the middle of March. The young plants, as soon as they have developed their first true leaves, are transplanted to stand about 2 inches apart each way and are allowed to develop in these quarters until they have attained a height of from 4 to 6 inches and the leaves begin to crowd considerably. They are then transplanted

to pots, 3 or 4 inches in diameter, similar to those used by florists, or, if these are not available, they may be shifted to strawberry boxes or to tin rims formed by melting the top and bottom from an ordinary 2-pound can used by canners in tinning vegetables. The heat which is necessary to unsolder the top and bottom of these cans will be sufficient to unsolder the seam at the side, which will leave a rim of tin about 5 inches in height and about 3 to 3½ or 4 inches in diameter. By tying a string around each rim it can be filled with soil and a young plant placed in this receptacle. By slipping a shingle under a can so prepared it may be shifted to the quarter where the plant is to grow until it attains the size desired for field planting.

With seed sown at the time mentioned it will frequently happen that plants handled in the manner described will be in bloom or even bearing small fruits the size of a marble before it is time to place them in the field. With careful handling at the time of placing the plants in the field these blossoms and fruits can be saved and will come to maturity and produce a very early and profitable crop.

TRAINING PLANTS TO STAKES.

For earliest returns it is desirable to train forced plants to a single stem by tying them to a stake 4 or 5 feet in height. A good stake for this purpose is formed by small saplings such as are used for training beans, or from a mill edge seven-eighths to 1 inch square. These stakes should be driven firmly into the ground beside the plants and the plants carefully tied to them to prevent whipping and to keep the fruits off the ground. All side shoots should be kept pinched out and only the central leading stem allowed to develop, as shown in figure 2. If the plants are to be trained in this way they can be set from 18 inches to 2 feet apart in the row, and about 3½ to 4 feet between the rows.

FIG. 2.—Plant trained to a stake.

TRAINING PLANTS ON FRAMES.

Another plan sometimes followed in the training of tomatoes is illustrated in figure 3. A flaring frame, about 18 inches square at the base and 24 inches square at the top, is placed over the plants before they begin to spread. The shoots as they become heavy with fruit fall over against the sides of the rack and are prevented from coming in contact with the earth. For a kitchen garden where but few plants

are grown this is a very satisfactory plan. The plants can be set somewhat closer than is the case where no supports are provided. For commercial plantations, however, the cost of the frames is prohibitive. The common commercial practice is to place the plants about 4 feet apart each way in check rows so as to allow them to be cultivated in both directions. Under intensive cultivation in a small garden, however, the first method, that of tying the vines to stakes, will be found very satisfactory.

FIG. 3.—Training plants by the use of frames.

EXTENSIVE CULTIVATION.

Where tomatoes are grown on a large scale and where the product brings only a small price per bushel, expensive methods of handling and training can not be profitably followed. The common practice in growing tomatoes for the general market and for canning purposes in localities north of New York City is to sow the seed very thinly in a hotbed about March 15 and allow the plants to grow slowly without transplanting them until they can be put in the field about June 1. The plants, even with the most careful attention, when grown under these conditions will become long and thin stemmed, with a small tuft of leaves at the top.

SETTING THE PLANTS.

Plants more than a foot high which have been grown under these conditions should be treated somewhat as follows: Instead of attempting to set the plant deeply and maintain it in an upright position, remove all except three or four of the topmost leaves about the growing point. Dig a shallow trench along the row—a trench 3 or 4 inches deep—slightly sloping from a deep point at one end to the surface of the ground at the other. Place the bare stem of the tomato and the root in this trench, with the root in the deepest portion, cover the stem throughout its length with fresh soil, and pack this firmly. Under these conditions the plant will take root throughout the length of the buried stem, and in a short time the added root system which is thus given the plant will force it into vigorous growth. Plants of this character which are to be grown on an extensive scale are never trained. They are allowed to grow at will, and the fruits are gathered as they ripen without special attention to keep them off the ground or otherwise to care for them.

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The construction of hotbeds for tomatoes is described in Farmers' Bulletin No. 195 of the Department of Agriculture, and for that reason is not repeated here.

SOIL AND YIELD.

The soil for the tomato varies as much as the localities in which it is grown. Judging from the extent of the tomato industry in Maryland and the fact that the greatest quantities of canned tomatoes are grown and packed in that State, one would naturally be led to the conclusion that the soil conditions there are ideal for the tomato. While it is undoubtedly true that the tomato can be more economically grown in Maryland than in any locality north of that point, it does not necessarily follow that the largest yield per acre is obtained in that State. The largest yields of tomatoes are undoubtedly obtained by careful handling of the plants and attention to fertilization and cultivation in latitudes north of Maryland. Accurately measured yields from areas of one-fourth acre and upward in Michigan have indicated a return of 1,200 bushels per acre, which is undoubtedly far in excess of the yields ordinarily obtained by even the best growers in localities where tomatoes are extensively produced for canning purposes.

LENGTH OF SEASON.

The season of fruit production is longer in the higher than in the lower latitudes. This is a rather interesting and unexpected condition. Normally one would expect to find that the tomato would begin maturing its fruit earlier and would continue bearing longer in the latitude of the city of Washington than it would in the latitude of Boston; but this is not the case. Tomatoes in the latitude of Washington and south of this point come into bearing, quickly produce a heavy flush of fruit, and then refuse to do more, and in order to have a continuous supply throughout the season it is necessary for market gardeners and truckers to plant seeds in succession so as to keep up a continuous supply. In fact, the common practice among truck growers is to make two sowings—an early sowing made about the 1st to the 10th of February, which will give fruits about July 15, and a second sowing from April 15 to May 1, plants of which placed in the field give a crop of fruit from September to November. In the latitude of Boston, however, plants from seed sown March 15 are usually transferred to the field about June 1, while upon the clay or gravelly loam soils of the terminal moraines these plants will grow continuously throughout the season. As soon as they begin ripening their fruit they will keep up a continuous supply until the vines are killed by frosts. For this reason the large yields previously mentioned become possible.

FERTILIZERS.

Since the tomato is grown exclusively for its fruit, those fertilizers which induce a large growth of plant and foliage are not desirable in the production of this crop. Soils vary greatly in regard to the quantity of available plant food they contain. The use of a fertilizer is determined largely by the character, mechanical condition, and composition of the soil. If a soil is deficient in all the essential elements of plant food—nitrogen, potash, and phosphoric acid—the application of any one or even two of them will not materially influence the yield of the crop. In such cases a complete fertilizer must be used. One containing a small percentage of nitrogen (1 or 2 per cent), with a high percentage of potash (4 to 6 per cent) and phosphoric acid (8 to 12 per cent), is considered more desirable than a higher grade fertilizer for the crop. On the other hand, on soils deficient only in potash or phosphoric acid, or both, little would be gained by adding nitrogen, which is already in excess, to the other element or elements to be applied. Economy of operation, as well as the general effect upon the soil, must also be considered. This may be influenced by the character of the season, but should be based on the increased yield and increased net receipts of the crop.

Tests of fertilizers.—The best and most economical fertilizers to be applied upon any given soil must be determined by the grower by actual test.

A very simple test of different fertilizers may be made by setting aside a section in one corner of the field or in some place where the soil is uniform and representative of the entire field. Use some good standard variety and divide the section into plats containing ten plants each, and treat somewhat as follows:

Plat 1. Nitrate of soda, one-half pound to 10 plants.
2. Muriate of potash, one-half pound to 10 plants.
3. Phosphate, 2 pounds to 10 plants.
4. Nitrate of soda, one-half pound; muriate of potash, one-half pound, to 10 plants.
5. Phosphate, 2 pounds; muriate of potash, one-half pound, to 10 plants.
6. Nitrate of soda, one-half pound; phosphate, 2 pounds, to 10 plants.
7. Nitrate of soda, one-half pound; phosphate, 2 pounds; muriate of potash, one-half pound, to 10 plants.
8. Barnyard manure, 1 shovelful per plant.
9. Unfertilized.

Keep a careful record of each plat separately, giving the date and quantity of each picking, including the green fruit that may be upon the plants when killed by frost. From such a record one can very easily determine the increased yield, as well as the influence upon the ripening period, if any, due to the application of each of the different

fertilizers, and from this the economy of its application will appear. This test may be modified by increasing or decreasing the amount of the various ingredients and comparing the results.

If plants are placed 4 feet apart each way, 2,722 will be required for an acre, and each plat will represent $\frac{1}{272}$ of an acre. Then, by multiplying the amount of fertilizer applied and the yield returned by 272, the corresponding quantity and yield per acre will be obtained.

Qualities required in fertilizers.—As a general rule, readily soluble, "quick-acting" fertilizers which produce an early growth and early ripening of the crop are most desirable. If nitrogen is needed, nitrate of soda is perhaps the best form in which it can be applied. It acts quickly but not through a long period, and for that reason is very desirable where short-season crops are concerned. In many cases it is found an advantage to apply the nitrate at two periods rather than all at once. It is well to make one application when the plants are set in the field and a second about the time the fruits begin to color. Fertilizers containing nitrogen in a slowly available form, such as cotton-seed meal or coarse, undecomposed stable manure, which do not stimulate an active growth until late in the season, are not desirable for this crop. Such fertilizers are too slow for a short-season crop like the tomato, which needs something to stimulate it at the very time it is transplanted to the field. Such fertilizers also tend to stimulate late growth of vine at the expense of the maturity of the fruit. Potash and phosphoric acid are more conducive to the development of fruits than is nitrogen, except in the form of nitrate of soda.

Heavy dressings of stable manure tend to produce too much vine, and are seldom or never employed. If stable manure is used it is at a moderate rate, usually not more than one or two shovelfuls to a plant. This, if well decomposed and thoroughly incorporated with the soil, is very stimulating to the young plant and consequently very beneficial.

Any fertilizer used should be applied, in part at least, at the time the plants are transplanted to the field.

CULTIVATING THE PLANTS.

As soon as the young seedling plants from the hotbed or greenhouse are transferred to the field they should be given clean cultivation with implements which stir the surface of the soil but do not produce ridges or furrows. The spring-tooth cultivator or a horse hoe with narrow teeth makes an ideal implement for cultivating this crop. When the plants are set in check rows 4 feet apart each way it is possible in field culture to keep the plantation almost free from weeds by the use of horse hoes. If, however, the plants are set so that cultivation can be carried on only in one direction, hand hoeing will be necessary to keep

down weeds between the plants in the row. Where land is not expensive, and where labor costs heavily, the cost of producing a crop of tomatoes can be decidedly lessened by planting in check rows and carrying on the cultivation by horsepower. A man with a modern cultivator and a well-trained horse can easily do the work of three or four men working with hand tools, and since the cost of production determines the percentage of profit, every legitimate means of reducing this item should be used.

The grower should bear in mind, however, that the object of cultivation is not merely to kill weeds. The destruction of weeds is an important factor and in itself sufficient to justify clean culture, but the preservation of a soil mulch for the purpose of husbanding the moisture of the soil during periods of drought is of even greater value. With care in the choice of implements both results can be attained with the same expenditure of labor.

HARVESTING AND MARKETING.

The fruits should be gathered two or three times a week if the tomato is grown as a truck crop. When used for canning purposes the harvesting periods need not be quite so close, and when the fruits are to be shipped some distance they should be gathered as soon as partially colored, instead of allowing them to become colored on the vine. The fruit of the tomato is velvet green up to the time the ripening process begins, and at this stage, if the products are to be shipped long distances, the fruits should be harvested. For home markets, however, the fruits should be allowed to ripen upon the plant.

FIG. 4.—Six-basket carrier for shipping wrapped tomatoes.

In harvesting, none except sound fruits of a similar stage of maturity should be harvested and packed in any one receptacle. Leaky fruits and deformed fruits should be rejected. In packing tomatoes for the market, those that are symmetrical in form and uniform in size and of a like degree of ripeness should be selected for filling any one receptacle.

Where the fruits are to be shipped long distances and have been picked in an immature state, the individual fruits should be wrapped in thin, pliable, brown or white paper, similar in grade to what is known as tea paper. When so wrapped and packed in small receptacles they may be shipped several hundred miles and go upon the market in good condition. In packing for long-distance shipments it

is the common practice to employ the six-basket carrier (fig. 4) now so universally used for the shipment of peaches. The wrapped fruits are carefully placed in the carrier baskets, and the baskets are then packed in a crate in the same manner as peaches. A flat box 18 to 20 inches square and about 5 inches deep, similar to the one shown in figure 5, which will carry two layers of wrapped fruit, is now extensively used in some sections of the country. The preference in packages, however, seems to be in favor of the six-basket peach carrier.

FIG. 5.—Flat box packed with wrapped fruits for shipment.

Formerly tomatoes which were grown and shipped less than 100 miles were packed in flat-handled baskets made after the fashion of the one shown in figure 6. A shallow basket made of splints with a folding handle or with one upright handle was employed. These baskets held something less than a half bushel. Fruits were gathered as soon as partially colored, carefully arranged in the baskets, and the baskets covered with mosquito bar. This style of shipment is not now very generally practiced except where the fruits are to be carried only short distances.

Fruits intended for the canning factory are allowed to mature upon the vines, are packed in short flat-handled baskets, as above described, or in bushel boxes, and are carried directly to the factory. The bushel box or slatted crate is undoubtedly more generally employed for this purpose than any other form of receptacle.

FIG. 6.—Basket for shipping tomatoes short distances.

VARIETIES FOR THE NORTH.

There are a large number of sorts of tomatoes, each one possessing some points of merit or difference which distinguish it from all others. These differences enable the intelligent cultivator to select sorts for special purposes, as well as for special soils and climates. The varying demands of the markets and the different soil and climatic conditions presented in the various sections of the United States where the tomato is grown can only be satisfied by a variety list as variable as are the

conditions. It is fortunate that domesticated plants present so many different forms; otherwise the cultivation of many crops would be restricted to a few favored localities. Besides broadening the field to which the tomato is adapted, varieties present other important differences manifested chiefly in the fruit.

Early ripening sorts are frequently irregular in shape, have comparatively thin walls, large seed cavities, and numerous seeds. The fruit is apt to color and ripen unevenly, remaining green around the stem, or to contain a hard green core. Later-ripening sorts, while not all superior to the others, have as a rule thicker and firmer walls, smaller seed cavities, and few seeds.

Desirable qualities.—The most highly developed varieties now make few seeds and ripen evenly. These characteristics of the fruits are important factors in determining their fitness for special purposes. Medium-sized, smooth, spherical fruits, which ripen evenly and have small seed cavities and thick walls, as shown in figure 7, are especially suited to long-distance shipment. These qualities should enter into every sort selected to the greatest possible degree consistent with earliness, lateness, heavy yield, or any other special quality which gives the variety a marked commercial advantage.

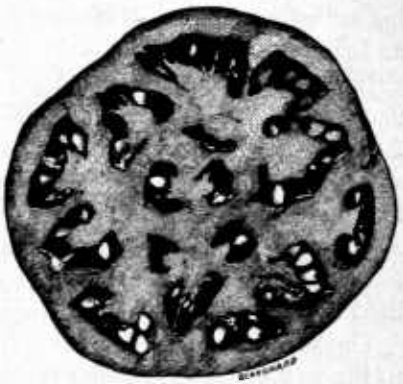

FIG. 7.—Cross section of tomato, showing the small seed cavities and thick walls of good shipping sorts.

The following list is made up of varieties possessing some markedly distinct character, such as earliness, great size, purple, red, or yellow color, dwarf habit, etc.:

Early ripening varieties.—Sparks' Earliana, Atlantic Prize, Early Freedom.
Large-fruited varieties.—Ponderosa, Beefsteak.
Purple-fruited varieties.—Beauty, Acme, Imperial.
Red-fruited varieties.—Favorite (late), Honor Bright, Matchless, Stone, Royal Red, New Jersey.
Yellow-fruited varieties.—Golden Queen, Lemon Blush.
Dwarf or tree types.—Dwarf Champion, Station Upright Tree, Aristocrat.
Potato-leaf types.—Livingston's Potato-Leaf, Mikado, Turner's Hybrid.

THE TOMATO AS A FIELD CROP AT THE SOUTH.

Commercial tomato growing in the Southern States is almost exclusively confined to the production of tomatoes at a season when they can not be grown at the North except in greenhouses. On this account the commercial production of this crop is restricted to areas where there is very little, if any, freezing during the winter months. Florida and Texas lead in the production of this crop.

TIME OF PLANTING.

At the extreme southern limit of the commercial cultivation of this crop in Florida the plants are grown so as to be ready for setting in the open about December 1. The date of seed sowing advances as the cultivation of the crop progresses northward, so that in northern Florida the seeds are sown early in January and the young plants placed in the field in March. Where frost conditions do not form barriers against the production of seedling plants in the open, the seed beds for the young plants are prepared in some sheltered situation where partial shade can be given and where the seed bed can be frequently watered. The young plants, as soon as they have attained the proper size—that is, from 6 to 10 inches in height—are transferred to the field in practically the same manner as are the hotbed-grown plants produced for general field culture at the North, and except for a specially early crop they are not transplanted or potted.

In the latitude of Savannah, Ga., the seed for a crop of tomatoes is usually sown in cold frames provided with glazed sash about January 1 to 10. The young seedlings do best if transplanted to other frames and placed about 3 or 4 inches apart each way by February 15, where they may be allowed to remain until planted in the open about April 1. Picking from such plantations will usually take place from June 1 to 10, about one month earlier than fruits can be expected from the field in the latitude of Washington, D. C.

The young seedlings in the cold frame will require careful attention in the way of watering and ventilation; otherwise many plants will be lost by damping off or from sun-scorching during bright days unless the sash are lifted or entirely removed.

FERTILIZING.

The plants are set from 3 to 4 feet apart in the row, with 4 to 6 feet between the rows. The ground is fertilized with commercial fertilizers containing from 1 to 2 per cent of nitrogen in the form of nitrate of soda, from 8 to 10 per cent of phosphoric acid, and from 4 to 6 and even 8 per cent of potash. A dressing of from 400 to 800 pounds to the acre is employed, and with clean cultivation the plants make a quick return. The fertilizer is almost exclusively confined to a strip 1 or 2 feet wide along the course of the row instead of being sown broadcast over the area.

TRAINING THE PLANTS.

It is customary to train the plants grown in this latitude to stakes from 2 to 2½ feet in height. The stalks of the plants, which are usually restricted to two or three in number, are tied to these stakes in order

to keep the fruits and the foliage off the ground and to expose the plants to the action of sun and air for the purpose of bringing the fruit to early maturity. A tomato plant as trained in this manner for this section is shown in figure 2.

YIELD OF FRUITS.

The yield of fruit in the South, under the conditions mentioned, is much less than it is in regions having the long growing periods characteristic of higher latitudes. Yields vary from 75 to 250 bushels to the acre, but the high price obtained for the fruits which are thus produced at a season when the sole competition comes from the products of northern greenhouses renders the crop, when well handled, very remunerative.

SOIL FOR THE CROP.

The soil which is preferred for the production of this crop is one which contains a comparatively high percentage of sand. In this region sandy loam or a sandy soil is preferred to bottom land for the cultivation of tomatoes. An area with a gentle slope to the south is considered more desirable than that with other exposure. If a windbreak can be secured along the north and west sides of the area very early crops can frequently be preserved through a wind storm when the temperature, while not low enough to freeze the plants, will, when accompanied by a high wind, chill and destroy them.

HARVESTING AND MARKETING.

Where tomatoes are extensively grown for shipment to the North, convenience, care, and judgment should enter into the preparation of the product for the market. It is always advisable and usually necessary to assort and grade the fruits as they come from the field before placing them in the shipping boxes. If this work can be done in a shed located on the railway over which the fruits are to be transported, so much the better, but if it is necessary to haul the tomatoes some distance for shipment then the packing shed should be located at the most convenient and accessible point for both harvesting and shipping. The same precautions in handling the fruits should be observed at the South as at the North.

Sorting and grading.—The fruits as they come from the vines should pass the scrutiny of experienced sorters and graders so that tomatoes of a certain size and degree of ripeness will reach the same shipping case. All leaky fruits should be excluded, and the stems, if any are found attached to the fruits, should be removed. Experience has shown that fruits are less likely to be broken and leaky upon arrival at their destination if all stems are removed than when this feature is neglected.

Packing.—The individual fruits are wrapped in a soft brown or white tea paper and packed in two-layer boxes or in the six-basket peach carrier already described (fig. 4). Fruits packed in this way and shipped by express are successfully carried from Miami, Fla., to New York, and from Corpus Christi, Tex., to Chicago.

Time of picking.—For the long shipments which are necessary in order to place the Florida and Texas grown tomatoes in the markets, the fruits are picked as soon as they have reached full development and show the slightest change in color. The stage of ripeness at which fruits should be picked and shipped should be regulated by the season as well as by the demands of the market for which they are intended. During cool weather the fruit should be riper when gathered than during the warm season. The most distant shipments should be filled from the least advanced fruits. These features would appear to be self-evident, but they are worthy of enumeration, for they are important factors in gaining the highest success.

VARIETIES FOR THE SOUTH.

In the South, where the tomato is handled as a short-season crop, certain varieties are found to give best results in certain districts. Along the Atlantic seaboard the growers of tomatoes use such sorts as Beauty, Stone, Perfection, Aristocrat, and Paragon.

In the truck regions of eastern Texas the Dwarf Champion is perhaps more universally grown than any other variety, but in this same region the Success is found to be a more profitable late-season or fall crop than the Champion.

SECOND OR LATE CROP TOMATOES.

At the present time the tomato growers of the South place their main dependence on the early crop, which comes in in advance of the tomatoes grown at the North and consequently finds competition only with the hothouse-grown product. There is, however, another very promising field for a limited number of truck growers in the Southern States in the production of a second or later crop of tomatoes which shall ripen during the months of September and October. The southern markets, which are each year becoming more and more important, are practically bare of tomatoes from early in July throughout the rest of the season, and some local growers who have taken advantage of this by growing a second or late crop are now reaping a very satisfactory harvest from such plantations.

The question of varieties which are adapted to this purpose is not well understood and each locality engaging in this work will of necessity be compelled to work out its own variety list. When this shall

have been determined the question of producing a second or late crop of tomatoes to supply the southern market will be much simplified, and a larger number of gardeners will find this a paying crop. At the present time the Success seems to be the only variety which is pre-eminently adapted to this purpose, particularly in the State of Texas.

FORCING TOMATOES.

In the forcing of plants, which means the growing of a plant out of its natural season and in an artificial environment, the first requirement for success is a properly constructed protective structure or greenhouse. Because of the tropical nature of the tomato more than ordinary provisions must be made in order to meet the demands of this crop. In the forcing of most vegetables a lower temperature and benches without bottom heat are satisfactory, but with the tomato the house must be piped so as to maintain a minimum temperature of 65° F., and the benches should be so constructed as to admit of applying bottom heat.

TYPE OF GREENHOUSE.

The type of house that is generally employed for the forcing of tomatoes is the even-span or a three-fourths span house. If the even-span house is used it is preferable to have the ridge running north and south; if the three-fourths span house is employed it is best to have the long side sloping toward the south. The tomato when grown in the forcing house, because of its long fruiting season and the fact that its clusters of fruit are borne one above the other, requires a considerable amount of head room. Low houses are therefore not desirable in the production of this crop. The side walls of a house designed for the forcing of tomatoes should be at least 4 feet in height, and the distance from the top of the middle bench to the ridge of the house should be at least 10 feet.

SOIL.

The soil for the production of this crop should be well decomposed loam, made, if possible, from sods from an old pasture, the soil of which is a rather light clay loam or a heavy sandy loam. With this should be incorporated about one-fourth its bulk of well-rotted stable manure, preferably cow manure. By composting these two materials for from four to six months before they are required for use a very satisfactory soil for the forcing of tomatoes will result. Care should be exercised to allow the soil that is used for forcing tomatoes to be frozen each year.

Depth of soil.—The depth of soil required for the successful growth of tomatoes is considerably more than that employed for roses, although

the temperature and other requirements are very similar to those demanded by the rose. While 4 or 5 inches of soil are adequate to produce a crop of roses, the soil for tomatoes should be at least 6 or 8 inches in depth; 8 inches is preferable.

Renewal of soil.—It is not well to allow the soil to remain in the greenhouse longer than a single season. It becomes somewhat exhausted and is likely to become infested with injurious forms of life, particularly nematodes, which cause root-knots upon the tomato plants, thus defeating the work of the gardener. This trouble, however, can be easily overcome by subjecting the soil to freezing.

Sterilizing the soil.—In localities where the winter temperature will not admit of renovating the soil by freezing, steam may be used to accomplish the same end. Sterilization can be carried on in boxes 12 to 15 or 18 inches deep, in the bottom of which are steam pipes with perforations every 2 inches, the perforations being about one-sixteenth of an inch in diameter and so placed that they are on the under side of the pipe. The pipes are arranged in coils and distributed far enough apart to allow the blade of a spade to be operated between them. A lid which is carefully fitted over the box should be provided, and the box should be made so as to hold 1 or 2 cartloads of compost. After subjecting the soil to the action of the steam a sufficiently long time to cook a potato buried in it the soil will have become thoroughly sterilized.

If a more permanent structure than the box is desired for sterilization, a brick pit, 18 to 20 inches in depth, can be arranged for the purpose. Good drainage should be provided. The bottom of the pit should be paved or concreted, and the side walls should be at least 9 inches thick and coated with cement to make them as nearly air-tight as possible. A tight-fitting lid will also be necessary for use in connection with this device. It is better, however, to make the pit shallow and broad or long, rather than deep, as the sterilization will be accomplished sooner in a comparatively shallow layer of soil than in a very deep one.

TEMPERATURE.

After the soil has been sterilized or after the compost has been made, as first described, the soil should be spread upon benches, which should be constructed so as to admit of placing steam or hot-water pipes beneath them in order to produce the desired amount of bottom heat. In order to secure the greatest economy both in labor and in space, the heating pipes may be placed very close to the surface of the ground and the bed in which the soil is to be placed should be constructed only a few inches above the heating pipes, thus making a very small air chamber beneath the bed, not to exceed 10 or 12 inches

between the bottom of the bed and the top of the floor or ground. With such an arrangement and with adequate openings along the sides of the benches the heat given off by the pipes beneath the bed will produce a sufficiently high atmospheric temperature for the tomato.

SEEDLING PLANTS.

Two types of plants are used for forcing purposes—seedling plants and cutting plants. The former are, of course, seedlings grown from seed especially sown for the purpose of raising plants to be grown in a greenhouse. It is customary in the latitude of New York and northward to sow the seed for a forcing crop of tomatoes in the month of August, August 15 being a common date for this operation. The young seedling plants, as soon as they develop the first true leaves, are then transplanted from the seed bed to small pots, preferably 3-inch pots. They are planted deeply at this time and are kept growing rapidly but not sufficiently to produce a soft, succulent growth. As soon as the 3-inch pots are filled with roots the plants are shifted to 4-inch pots, and when the plants have attained a height of 12 or 15 inches, and have developed their first blossoms, they are usually placed on the benches of the greenhouse, where they are to produce their crop. The plants are then set 15 or 18 inches apart each way in a soil prepared as previously described. The plant represented in figure 8 is a good example of a plant suitable for use in a forcing house.

FIG. 8.—Pot-grown plant, ready for transplanting to forcing house or field.

CUTTING PLANTS.

Cuttings should be taken from strong, healthy, vigorous-growing plants in the field, and placed in the cutting bed about the last of August, where they will quickly take root. As soon as the roots have developed to a length of from one-half to 1 inch the young plants are shifted to 3 or 4 inch pots, where they are allowed to develop until the blossom buds are well formed or the blossoms have expanded, when they should be planted on the bench where they are to mature their crop, in like manner as noted for seedling plants.

Cutting plants are somewhat shorter jointed and come into blossom sooner than seedling plants, and for this reason they may be started somewhat later than the date mentioned for sowing seed.

TRAINING THE PLANTS.

Tomato plants in forcing houses are usually grown to a single stem, as shown in figures 9 and 10, or at most with two or three stems, as shown in figure 11. The houses are provided with wires running parallel to the rows and immediately over them, the wires being fastened by screw-eyes or staples to the sash bars, as indicated in figure 12, which gives a general view of a tomato forcing house. In many instances parallel wires are also fastened to the top of the bench and pass close to the rows of plants. Strings, preferably tarred, similar to the tarred strings used by farmers for tying corn fodder, are used between the two wires and to form a support to which the stems of the tomatoes can be tied.

FIG. 9.—Single-stem plant in forcing house, showing method of tying fruit cluster.

The tying of tomatoes should be carefully done. Raffia should be used for this purpose and should be passed around the supporting string two or three times to bind the raffia to the string, so that when a loop is passed under a fruit cluster or under a leaf, as shown in figure 9, the stem of the tomato will be held up to the string and still allow sufficient room for the growth and thickening of the stem of the plant. If the stalk of the plant is tightly tied to the supporting string or wire it is liable to be girdled. As the plants come into fruit and the fruit clusters develop it will be necessary to pass a band of raffia under one of the subdivisions of the fruit cluster and around the stem of the plant or around the supporting string in order to prevent the fruit cluster from being broken close to its point of origin by the weight of the fruit. When once broken the nourishment to the developing fruits is cut off and the development from that time on is unsatisfactory.

POLLINATION.

In the field, where the tomato plants are exposed to the action of wind and to the visits of insects, no special attention is necessary in order to secure the pollination of the flowers and the setting of the fruits. Under the conditions existing in a greenhouse, however, it is necessary to artificially pollinate the flowers of the tomato; otherwise only a very small percentage of fruits will set and the object of the work will be defeated. It is therefore necessary to allow the temperature of the house to become quite high in the middle of the day on bright sunshiny days while the plants are in bloom, and to pass through the house at this time with a little stick, 18 inches or 2 feet in length, with which to strike the supporting strings or wires and thus to set the plants in motion and liberate the pollen and cause it to fertilize the flowers.

FIG. 10.—Bench of single-stem plants.

A more satisfactory way, however, is to use a watch glass, 1¼ or 1½ inches in diameter, embedded in putty, at the end of a handle composed of a light material, preferably white pine, which shall be 12 or 18 inches long, as shown in figure 13, B. Grasp this spatula in the left hand and, with a light pine stick of equal length (fig. 13, A) in the right hand, pass through the house, tapping each open flower lightly with the wand, at the same time holding the watch glass under the flowers to catch the pollen. Before removing the watch glass from this position lift it sufficiently to cause the stigma of the flower to dip into the pollen contained in the glass.

By carefully going through the house from day to day during the blooming period nearly 90 per cent of the blossoms which develop can be caused to set. During dark, cloudy, stormy weather, however, a smaller percentage of plants will be fertilized than during bright, comparatively dry weather. The conditions in the greenhouse can not be modified so as to entirely overcome the adverse conditions existing on the outside, although with care much can be done in this direction.

MANURING.

It is desirable to keep plants of the tomato which are designed for forcing growing at a moderately rapid rate throughout the whole forcing period. Growth should be strong and robust at all times, yet slow enough to produce close-jointed plants which bear their fruit clusters at near intervals. There is considerable difference in varieties of tomatoes in this respect, and those which naturally bear their fruit clusters close together should be selected for forcing purposes. The manuring of the plants should, therefore, take a form which will be conducive to this strong, vigorous growth, yet not sufficiently heavy to produce plants which run to wood at the expense of fruit bearing. If a nitrogenous fertilizer is to be used, nitrate of soda in solution is preferable to the slower acting forms commonly employed in greenhouse operations, such as bone meal, cotton-seed meal, and sheep manure. It is better to use an artificial fertilizer than stable manure for producing strong growth in the plants during the forcing period. Nitrate of soda, sulphate of potash, and acid phosphate can be combined so as to give the desired proportions of nitrogen, phosphoric acid, and potash.

FIG. 11.—Plant trained to three stems.

INSECT ENEMIES.

Forced tomatoes are, as a rule, not seriously infested by the common insect enemies of the greenhouse, with the exception of species of mealy bug and white fly.

Mealy bugs can be destroyed by spraying the plants with a solution of a cheap neutral soap in water or by fumigation with hydrocyanic-acid gas. The white fly (*Aleyrodes* spp.) can be held in check by fumigation with tobacco stems or with one of the modern tobacco smudges now upon the market. For information in regard to remedies for the greenhouse white fly, see Circular No. 57 of the Bureau of Entomology, Department of Agriculture.

VENTILATING AND WATERING.

If careful attention is given to keeping the plants in a healthy condition by never allowing them to suffer from overwatering or from becoming too dry, and if sufficient ventilation is given without allowing draughts of cold air upon the plants, much can be done to prevent the development of mildew. If the plants are to be sprayed it should be done once a week or once in ten days, and then only in the mornings of bright days. Ordinarily, however, the atmosphere of the house should be kept dry rather than moist, as a very moist atmosphere is liable to produce a soft, succulent growth, which brings on a disease known to gardeners as œdema. This, however, is only a

FIG. 12.—House of tomatoes, showing wires and strings for training plants.

physiological condition and can be prevented by care in keeping the house rather dry. The temperature of the house, too, should not be allowed to fluctuate through too wide a range. The night temperature for tomatoes should range between 65° and 68° F., while the day temperature should run from 70° to 80° F.

GATHERING THE FRUITS.

The individual tomatoes as they ripen should be cut from the cluster so as not to interfere with or disturb the remaining fruits, and a portion of the stem should be left adhering to the calyx. Fruits gathered in this way present a more pleasing appearance and are less liable to be leaky. For special markets close at hand it is not necessary to

specially wrap the fruits, as they are usually sold by the pound. For shipment, however, it is best to wrap the fruits in tea paper, either white or brown, and to pack them carefully in carrier baskets similar to those used by growers for the shipment of peaches. The yield of a plant grown in the manner described should range between 4 and 10 pounds, the average being about 5 or 6 pounds.

VARIETIES FOR FORCING.

The comparatively limited use of tomatoes for forcing purposes in this country has not resulted in the development of many sorts especially suited for this purpose. The Lorillard is the one American sort which is now almost exclusively confined to this use, and it is perhaps more generally cultivated in forcing houses than any other single variety.

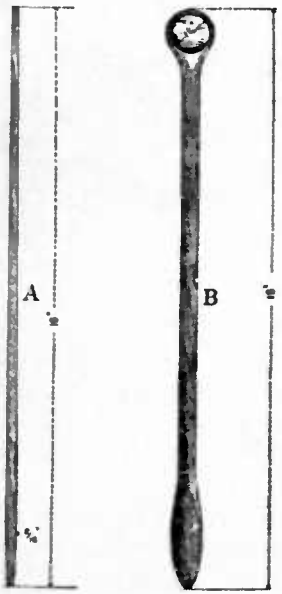

FIG. 13.—A, Wand used in pollinating flowers. B, Spatula used in polliuating flowers.

THE TOMATO AS A FIELD CROP FOR CANNERIES.

The tomato is so extensively grown as a field crop that it may seem as though little could be added concerning the methods to be observed in growing the crop for canning purposes. Success, however, requires definite knowledge and careful practice along the four lines already emphasized: (1) The selection of the variety; (2) the growing of the plants; (3) the selection and preparation of the soil, and (4) the fertilizing and cultivation of the land.

SELECTING THE VARIETY TO GROW.

Owing to the fact that in canned tomatoes it is difficult for the average consumer to note any deficiencies in the appearance of the original fruit, many labor under the delusion that any variety will answer for this purpose. This is a mistaken idea, as quality in canned goods is now an important factor, and it is quite as necessary that a good quality of product should be used for canning as for growing for the early or general market, although from the field side it is natural that tonnage should be a primary consideration.

In the matter of varieties, as in the case of early tomatoes, too much dependence should not be placed upon the name or upon the fact that a neighboring farmer secures good results from a given variety. There are so many variations in the character of soils, even in the same locality, which exert an influence upon the size and quality of crop that the best variety is usually one that is, in part at least,

developed by the individual grower. The main point is to select varieties that produce large, smooth, solid fruits, which do not remain green or crack on the shaded side near the stem. Those which possess size as their chief characteristic are frequently of poor quality, as they are likely to possess large seed cavities and to ripen unevenly. The Stone, Paragon, Ten Ton, Cumberland Red, and Livingston's Perfection are all varieties that have been grown with advantage. In fact, in many localities the variety giving best returns has no trade name, neither is its place of origin known. Thus it assumes a local name, as, for example, in New Jersey the "Jersey Red" is probably grown more largely than any other sort, though it possesses very different characteristics in different localities, and is a development and improvement of some good variety introduced at an earlier period.

The conditions in some sections are such as to prevent the canners from making as much distinction between good and poor varieties as they would like. Canneries are in a measure obliged to receive all that come, unless they can control absolutely the land upon which the crop is grown. The variation in the quality of the crops of different farmers will make a difference of from 25 to 40 cans on a ton of fruit, or from 6 to 10 per cent—a very considerable item. In good seasons and with good fruit 400 cans may be regarded as the maximum number to be derived from a ton, though late in the season, and with poor varieties, as already stated, the pack from a ton is very much less. The interests of the grower and the canner are really identical in this regard. An improvement in the quality of the fruit will result in an improvement of the canned product and a consequent increase in the price of both the raw and manufactured products.

GROWING THE PLANTS.

Less expense is involved in growing suitable plants for cannery purposes than for other crops. This is due to the fact that earliness is not so important a factor as it is in the market garden crop. On this account the seed bed for the cannery crop can be prepared without the use of sash or frames. A sheltered situation where north and west winds are cut off but with full exposure to the south will serve for this purpose in New Jersey, Maryland, and States to the south. The seeds should, however, be planted early in April and the plants be ready to go into the field about the first of June. In localities where planting can not be safely done in the open at this date recourse should be had to cold frames.

The soil of the seed bed in the open should be a warm, well-drained sandy loam, deeply spaded, carefully raked, and made smooth before sowing the seeds.

The seeds should be sown shallow, about one-half inch deep, the surface compacted by use of a board, which may serve as a walk for the workmen while sowing the seeds as well as a marker for laying off

the rows. The rows may be 3 or 4 inches apart and rather broad, with the seed scattered thinly in a belt. In some cases it may prove an advantage to place a light mulch of coarse litter or cut straw over the seed bed immediately after planting. In all cases, however, the mulch should be removed before the seed breaks the ground; otherwise the plants will be drawn and valueless. When the plants are an inch high the soil should be stirred. This stirring should be repeated frequently, particularly after each rain, as it induces more rapid growth and more freely admits the warm air to the roots of the plant. Unless there is an abundance of rain, careful attention should also be given to watering, as the plants require a great abundance of water.

If all these precautions are carefully observed and the work properly carried out, good, strong, well-rooted plants should be ready for the field from the first to the middle of June—the time at which they are usually set in New Jersey or Maryland. In States farther south the planting of the seed would naturally be a little earlier, thus making the setting in the field proportionally earlier.

SELECTING AND PREPARING THE SOIL.

The tomato as a field crop is adapted to a wide variety of soils, though a medium clay loam is probably the best. In fact, any soil well adapted to potatoes will grow the tomato to good advantage. The previous treatment, however, has an influence on the best development of the crop, and a clover sod, or a soil upon which corn has been the preceding crop, is perhaps the best. In either case the land should be deeply cultivated, preferably in the autumn or early spring, in order to improve its physical character and to destroy injurious insects, which may be troublesome later. It is also desirable where it is the practice to use manure, particularly if it is coarse, to spread it during the winter, in order that the soluble portions may become thoroughly distributed in the soil. As soon as the land is ready to work in the spring it should again be plowed shallow and then deeply cultivated in order to thoroughly warm up the soil and to incorporate in it the coarser portions of the manure.

FERTILIZING AND CULTIVATING THE SOIL.

In manuring and fertilizing, the character of the crop and the season of its growth should be remembered. Hence, recommendations that were made in these pages for an early crop do not apply in all cases except perhaps on the poorer classes of soils. In the first place, the plants are not put in the soil until summer, when the conditions are most favorable for the rapid change of organic forms of nitrogen into nitrates, and thus, if the soil has been manured or is naturally rich in vegetable matter, the additional application of nitrogen in immediately available forms is not so important. In the second place, the object of the growth is not early maturity, but the largest yield of mature fruit.

It is more desirable to grow a larger plant than in the case of early tomatoes. The fertilizing should be, therefore, such as to furnish an abundance of all the elements of plant food.

Since the tomato belongs to the potash-consuming class of plants, the fertilizers used should be especially rich in potash. It is not to be understood, however, that it is not necessary to apply nitrogen, for frequently soils are used that are either not naturally well adapted to the plant or have not been previously well supplied with vegetable matter containing nitrogen. On such soils additional nitrogen is very important, and nitrate of soda is one of the best forms to use, as it is absorbed fully by the roots, thus encouraging an early and vigorous growth of plant and a normal development of fruit. Slow-acting organic forms of nitrogen, on the other hand, frequently begin to feed the plant and cause its rapid growth when the energies should be concentrated in the growth and maturity of the fruit.

Fertilizers that have proved excellent are those which contain a relatively smaller amount of nitrogen than is required for early tomatoes and larger quantities of phosphoric acid and potash.

Character of fertilizer.—On a good soil which would without manure produce 5 to 6 tons there should be added a sufficient excess of nitrogen, phosphoric acid, and potash to provide for a maximum crop, and the fertilizer should be relatively richer in nitrogen and potash than in phosphoric acid. A mixture of nitrate of soda 400 pounds, bone tankage 700 pounds, acid phosphate 400 pounds, and muriate of potash 500 pounds, would contain approximately 95 pounds of nitrogen, 144 pounds of phosphoric acid (48 pounds of which would be soluble and available), and 250 pounds of potash in each ton.

An application of 500 pounds of this mixture to the acre would furnish half as much nitrogen as is contained in 10 tons of crop, nearly as much immediately available phosphoric acid, and two-thirds as much potash. Hence, a dressing containing the quantities, kinds, and proportions of plant food here indicated would be regarded as very desirable, since one-half of the nitrogen is in the form of nitrate, which would contribute to the immediate growth of the plant. The quantity of soluble and available phosphoric acid is sufficient to satisfy the needs of the crop throughout its entire growth, and an abundance of potash is present to insure the maturity of both plant and fruit. Formulas of this character have been used with good success, though the large proportion of salts sometimes makes mixtures of this sort too moist to handle well, in which case a part of the potash, or even the nitrate, may be applied separately with advantage.

On poorer soils the artificial supply of plant food should be proportionately greater, or sufficient to provide for the entire needs of a fair-sized crop, since as a rule the relative power of the plant to acquire

food is somewhat less on poor soils than on good soils, or, stated in another way, the results from the use of fertilizers are proportionately better upon soils in good condition than upon those not well cared for. A good formula for use on these soils may consist of nitrate of soda 500 pounds, bone tankage 500 pounds, acid phosphate 400 pounds, and muriate of potash 600 pounds.

One ton of this mixture would furnish approximately 105 pounds of nitrogen, 120 pounds of phosphoric acid, and 300 pounds of potash. The application of 1,000 pounds of this mixture to the acre would furnish sufficient food in good proportions to meet the demands of a fair crop. The advantage of using so large a proportion of nitrogen in the form of nitrate is that in this form it is immediately available and induces the immediate and rapid growth of the plant, and thus it prevents too late a growth by furnishing a minimum of organic nitrogen, which would become available late in the season.

The cost of the fertilizer suggested in these cases, though apparently rather large, should not exceed $15 per acre, and is no more than would be required for fertilizers to insure a maximum crop of corn or other field crop on the soils described. Besides, it must be remembered that the quality of the crop would be greatly improved. The necessity for so expensive a dressing could be materially lessened by reducing the need for nitrogen, and this could be accomplished by sowing crimson clover with or after the previous crop of, say, early corn or potatoes; in fact, if weather conditions are favorable, crimson clover may be seeded in the tomato fields in August after cultivation has ceased, or at the last cultivation, and a crop of clover grown which will provide nitrogen for the next year's crop. This method is now practiced with advantage by many growers. The cost of manuring or fertilizing tomatoes on soils in good condition, and which have been well managed for previous crops in the rotation, should not exceed $8 per acre.

SETTING AND CULTIVATING THE PLANTS.

The plants should be set from 4 to 4½ feet apart each way and cultivation should begin immediately. The first cultivation should be deep, in order to conserve the moisture, and each subsequent cultivation shallower, in order not to destroy the roots, which will fill the soil as soon as the plants reach maturity. The crop in good seasons should begin to ripen in August, and picking will continue from that time until the last of September.

COST, YIELD, AND VALUE OF CROP.

The cost of production per acre is much less for fruit for canning than in the case of early tomatoes, the chief difference being in the production of the plants. The several items may be classified as follows:

Cost of growing an acre of tomatoes for canning.

Plants	$2
Manures and fertilizers	8
Preparation of land, setting plants, and cultivation	8
Picking and carting	10
Total	28

The yield, as in the case of the early tomatoes, varies widely, ranging from 5 to as high as 20 tons per acre, even 30 tons per acre having been reported in exceptional cases, although the average for a series of years on average land will probably be under 8 tons. Where all conditions are carefully observed, 20-ton yields are frequently obtained, and at the prices received at the cannery, ranging from $5 to $7.50 per ton, according to the locality, the crop is a fairly good one and the net profits are quite as large as for other field crops.

CONTRACTS BETWEEN GROWERS AND CANNERS.

The agreements made between the growers and canners differ somewhat, though the main object on the part of the canner is to secure sufficient tonnage to maintain the factory during the ripening season. It would seem that the fairest form of contract would call for the product of a certain number of acres rather than the delivery of a certain number of tons. It is impossible for the farmer to anticipate the season, and therefore he can not safely contract to deliver a definite number of tons. The following form of contract, which is generally used in New Jersey, is good and protects both the producer and the canner:

This is to certify that we ——— have bought of ——— the product of —— acres of tomatoes for the season of ——— at $—— per ton, delivered at our cannery at ———. Stock to be in first-class mercantile condition. To be planted about ———.

Provisions are frequently inserted in contracts to cover the date of the beginning of the delivery, as well as to protect the cannery in case of fire, accident, or other contingency.

The cooperation of farmers in the ownership and management of a cannery is practiced in a number of places in the United States, though it is not general.

THE DISEASES OF THE TOMATO.

Leaf-spot and leaf-mold, two fungous diseases of similar nature, are marked by the appearance of small, round, or irregular spots on the leaves, causing them to curl and finally die. Both are easily prevented by thorough spraying with Bordeaux mixture. The applications should begin soon after the plants are transplanted and be repeated at intervals of ten days through the season.[a]

[a] See Farmers' Bulletin No. 91 for directions for preparing Bordeaux mixture.

The principal greenhouse disease of tomatoes is a mildew (*Cladosporium fulvum*), which grows on the under surface of the leaves, causing yellow discolorations, distortion, gradual drying, and finally death. The fungus usually appears first on the lower and older leaves which have partly lost their vitality. The plant should, therefore, be carefully watched for the earliest appearance of the disease and immediate steps taken for its eradication. One of the best methods is to spray the plants at intervals of seven to ten days with Bordeaux mixture or with a solution of ammoniacal carbonate of copper, made as follows: Dissolve 5 ounces of copper carbonate in 3 pints of strong ammonia and add 45 gallons of water. This solution, applied with a pump having a fine nozzle, such as the Vermorel, will prove effective against the disease.

Fruit-rot is combated with more or less success by pruning and training vines to admit light and air, together with the destruction of all diseased fruits, to prevent the spread of infection.

Wilt, principally a southern trouble, is due to three distinct parasites. The *Fusarium* wilt, most prevalent in southern Florida, compels rotation of crops. Tomatoes in this section should not be planted on the same land oftener than once in four or five years. The *Sclerotium* wilt attacks tomatoes and many other vegetables in the Gulf States and requires rotation of crops and the destruction of diseased plants. In the autumn, dead plants and decaying matter of all kinds should be removed from the garden and burned. The bacterial wilt, the most common tomato disease from northern Florida to Maryland, is spread mainly by leaf-eating insects, though the infection probably remains in the land as well. Spraying with Bordeaux mixture and Paris green, together with the destruction of diseased plants as soon as observed, is advised.

Root-knot is characterized by the formation of irregular galls on the roots of infected plants, due to the invasion of minute nematodes or eelworms. Most garden crops are attacked by this disease, but tomatoes are especially susceptible. They should not be planted on infected ground. Rotation with crops that do not harbor the worms tends to free the land from this disease. Nematodes are not troublesome in the field except in the South. For treatment of nematodes in the greenhouse see page 20.

Western blight or yellows, prevalent in the Rocky Mountain States, is due to a cause not yet fully known, though probably connected with unfavorable soil conditions. These should be improved by drainage, fertilization, cultivation, and irrigation, and great care should be used in transplanting not to injure the young plants.

Other diseases, of minor importance except in occasional instances, are: Oedema (see page 25), rosette (Rhizoctonia), and mosaic disease.